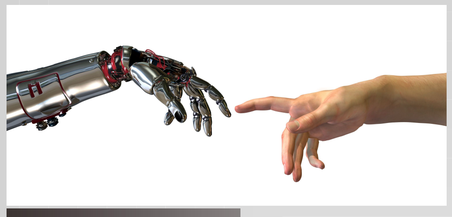

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Artificial Spatial Cognition for Robotics and Mobile Systems: very brief survey and current open challenges

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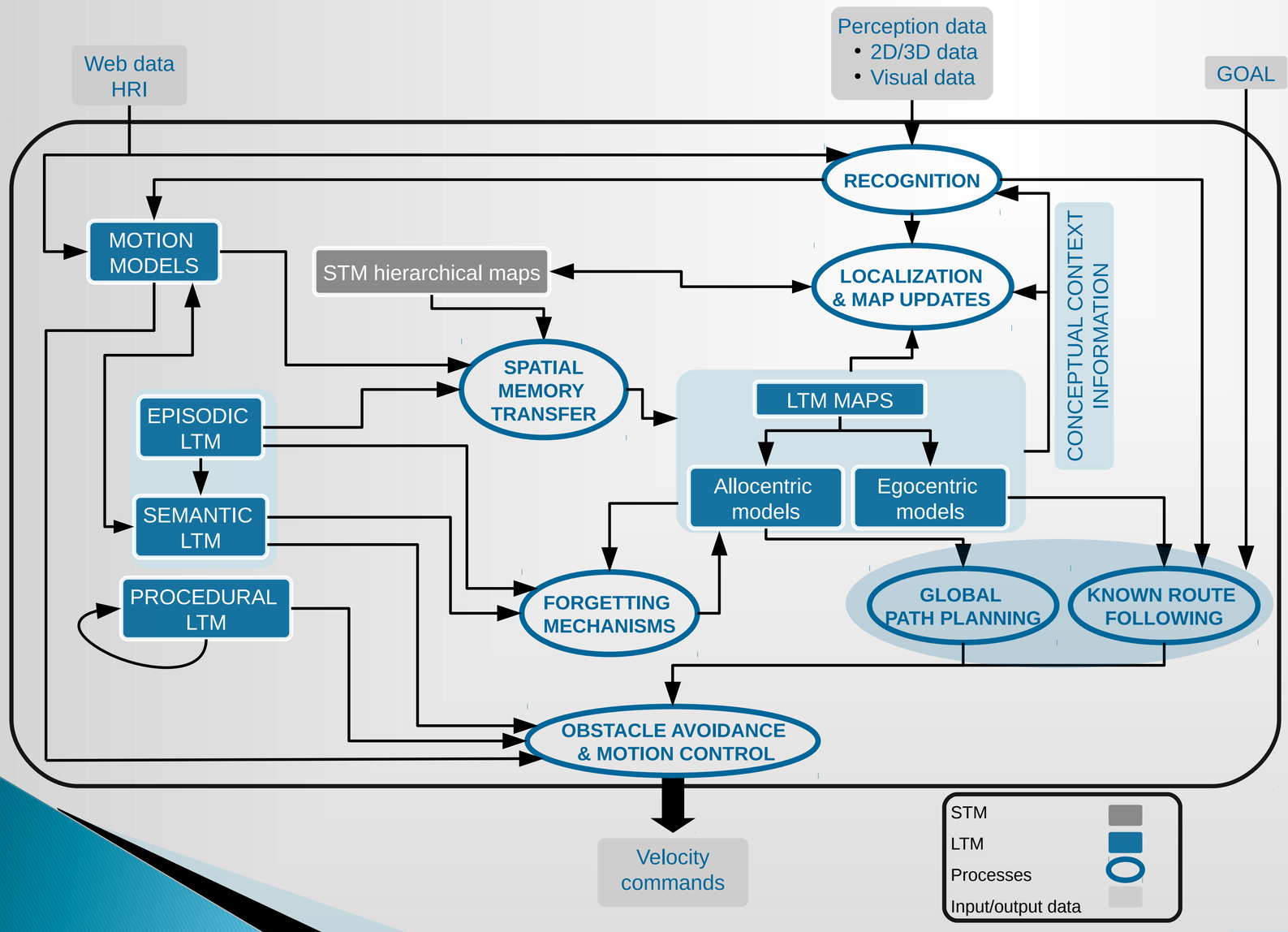
Remarkable and impressive advancements in the areas of perception, mapping and navigation of artificial mobile systems have been witnessed in the last decades. However, it is clear that important limitations remain regarding the spatial cognition capabilities of existing available implementations and the current practical functionality of high level cognitive models [Jefferies and Yeap, 2008][Madl et al., 2015]. For enhanced robustness and flexibility in different kinds of real world scenarios, a deeper understanding of the environment, the system, and their interactions -in general terms- is desired. This poster aims at outlining connections between recent contributions in the above mentioned areas and research in cognitive architectures and biological systems. We try to summarize, integrate and update previous reviews, highlighting the main open issues and aspects not yet unified or integrated in a common architectural framework.

ADDRESSED TOPICS

Cognitive architectures	Topic	Perception, Robotics, Vehicles Algorithms References
ACT-R/S, CLARION	Egocentric spatial models	[Droully et al.'15][Posada et al.'14]
LIDA, SOAR-SVS	Allocentric spatial models	[Cadena et al.'16][Richardson & Olson'11]
Casimir, LIDA, SOAR-SVS	Object based/ semantic representations	[Salas-Moreno et al.'11][Eslami and Williams'12][Uckerman et al.'12][Pronobis et al.'12]
SOAR-SVS	Explicit motion models / dynamic information about the environment	[Ambrus et al.'14][Rosen et al.'16]
All	Memory management, forgetting mechanisms	[Dayoub et al.'13]
Extended LIDA [Madl et al.'16]	Uncertainty considerations	Most mapping and navigation approaches

SUMMARY OF SURVEYS

Topic	References
Robotics and Cognitive Mapping	[Jefferies and Yeap'08]
SLAM and Robust Perception	[Fernández-Madrigal and Blanco'12][Cadena et al.'16]
Computational cognitive models of spatial memory in navigation space	[Madl et al'15]
Object recognition	[DiCarlo et al'12][Roth & Winter'08]
Cognitive Architectures for Robotics	[Kurup and Lebiere'12][Kajdocsi et al.'14]
Spatial knowledge in brains	[Moser & Moser'16]



CURRENT OPEN CHALLENGES

- **Closing the gap between high level cognitive architectures and actual implementations for robust perception and navigation competences in artificial mobile systems**
  - Combination of allocentric and egocentric models using different levels of features/objects + topology/semantics.
  - Acquisition and integration of motion models and dynamic information for the elements/objects.
  - Integration of global mapping & loop closure capabilities with extensive declarative knowledge about features relevance and forgetting mechanisms. Management of STM and LTM for localization and navigation.

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